HOW TO ESTIMATE RAINWATER HARVESTING SAVINGS AT URBAN LEVEL?
A scale-adaptive method

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1. INTRODUCTION

A basic rainwater harvesting system comprises three main components:

1) a collection surface

2) a water storage tank

3) a system connecting the two previous components and linking to the devises using rainwater (piping and pumps)

Modern rainwater harvesting systems encompass other elements, such as:

- a first flush device
- a filtration device
- a water treatment system

Despite the possibility for using for potable uses, most codes in developed countries limit the use of rainwater for non-potable uses.

1. INTRODUCTION

Water, despite being renewable, is a limited resource. In fact, fresh water reserves are scarce and many regions of the globe are or will be in water stress situation in a near future due to:

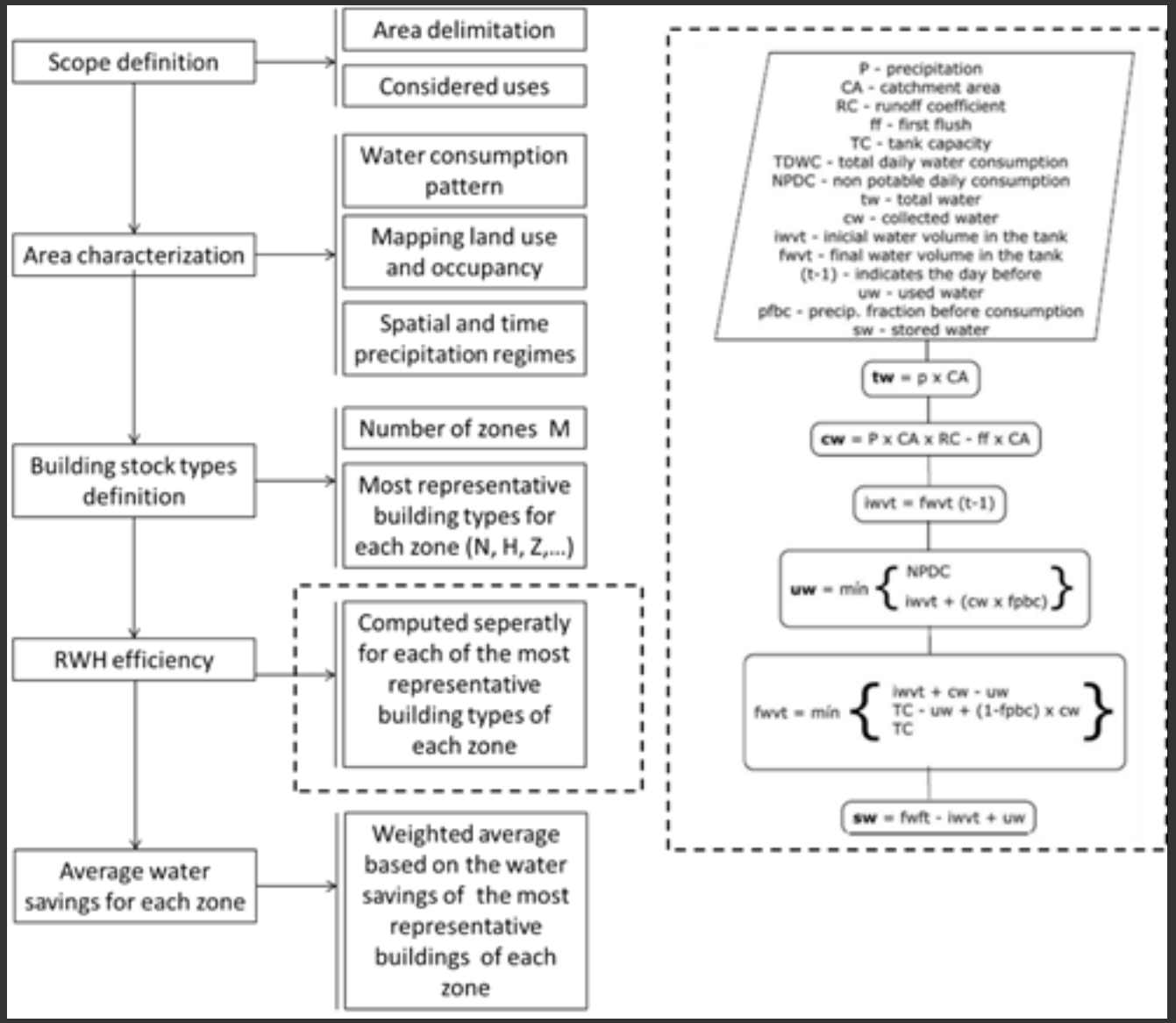
- consumption increase (population growth and higher per capita water demand)
- decreasing fresh water resources (pollution and climate changes related issues)

Reverting this scenario can be achieve through a combination of strategies that can be grouped into:

- water consumption reduction
  - structural measures (e.g., water efficient fixtures and appliances)
  - non-structural measures/behaviour change (e.g., pricing schemes, awareness campaigns)

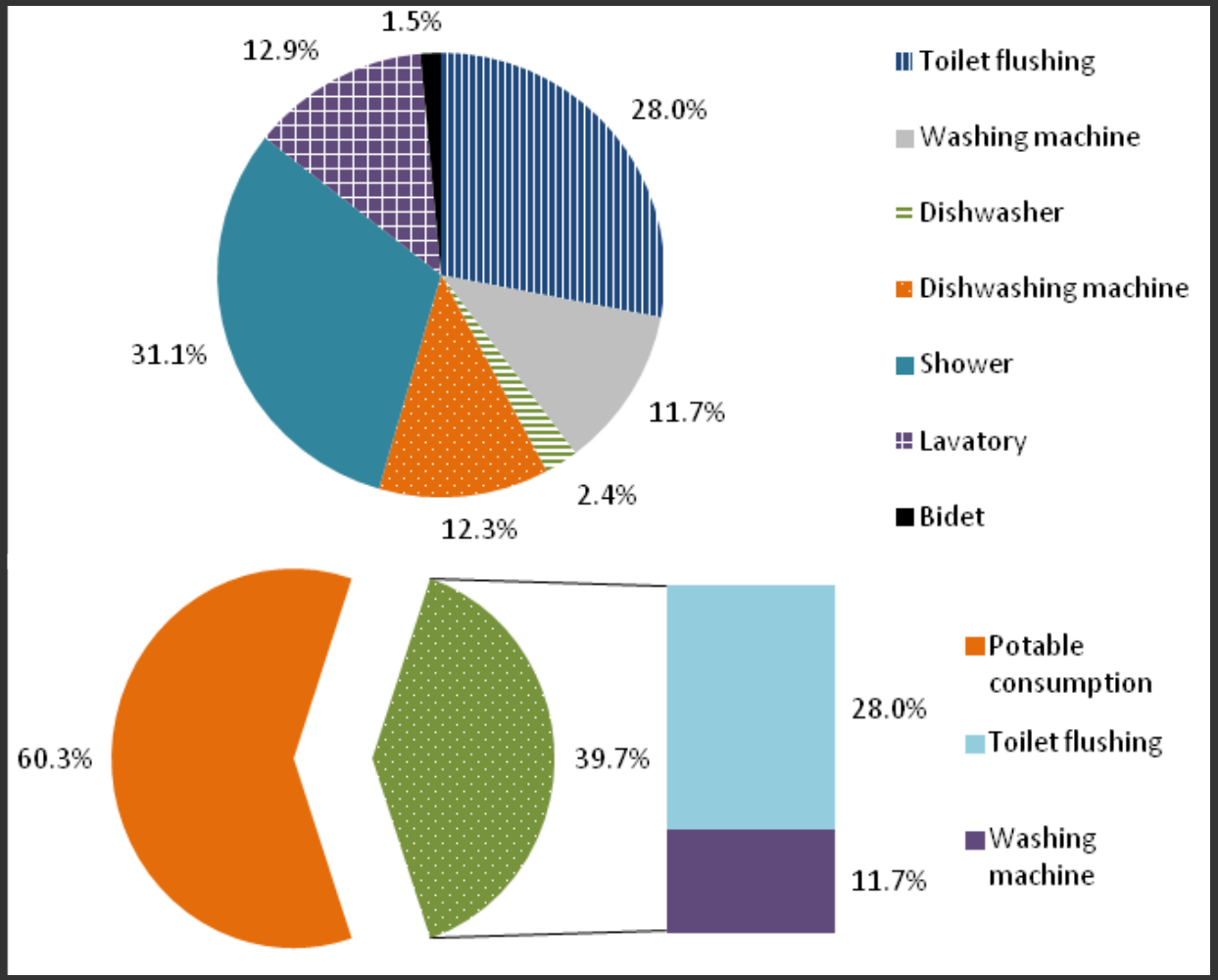
- alternative water sources (e.g., rainwater harvesting)

2. METHODOLOGY

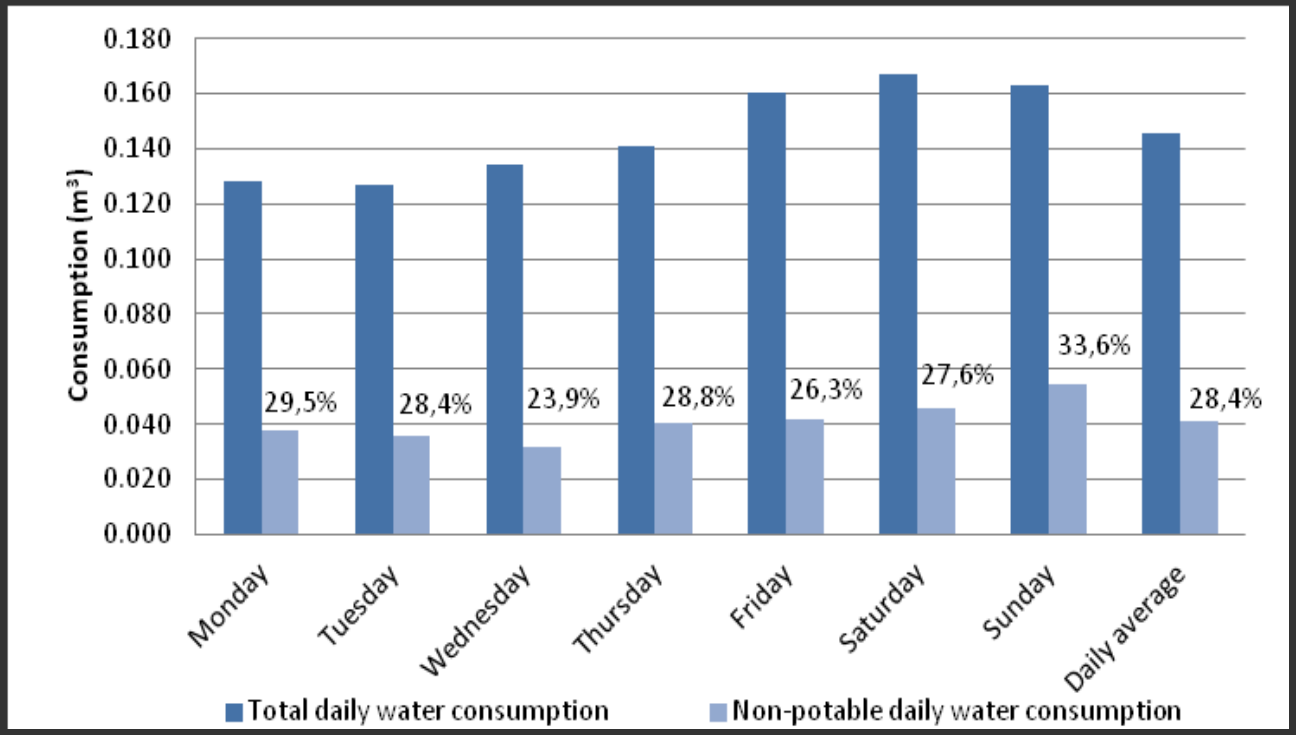


3. CASE STUDY

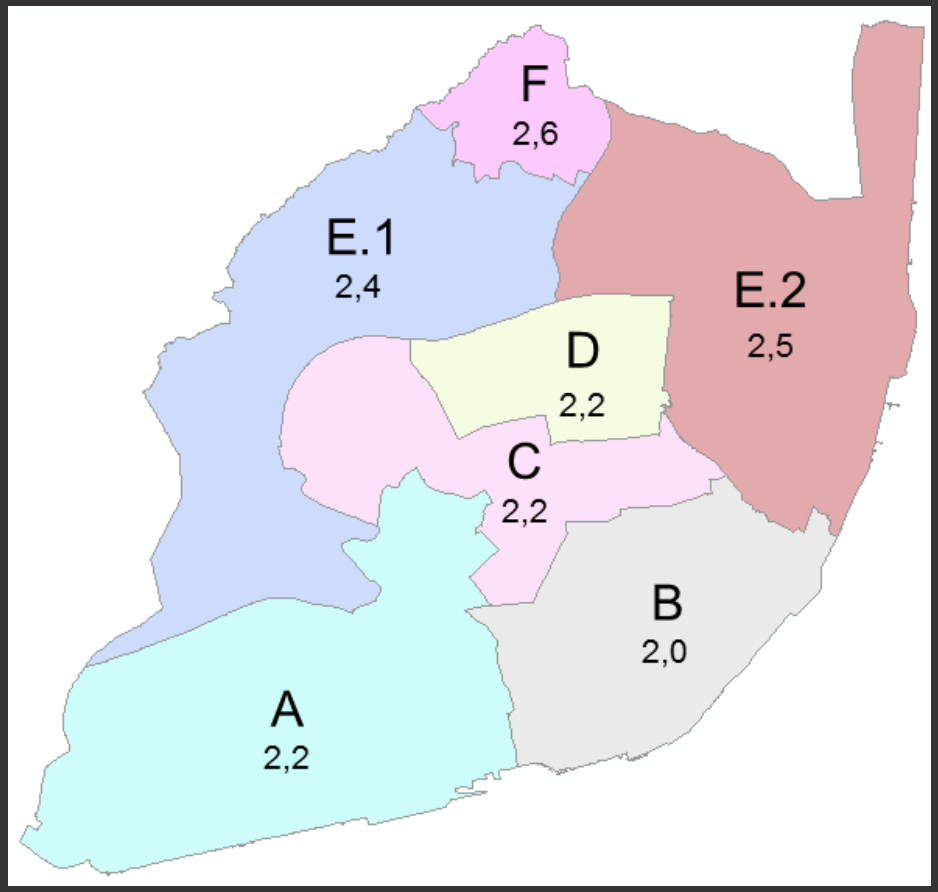
3.1. Water consumption



3.1. Water consumption



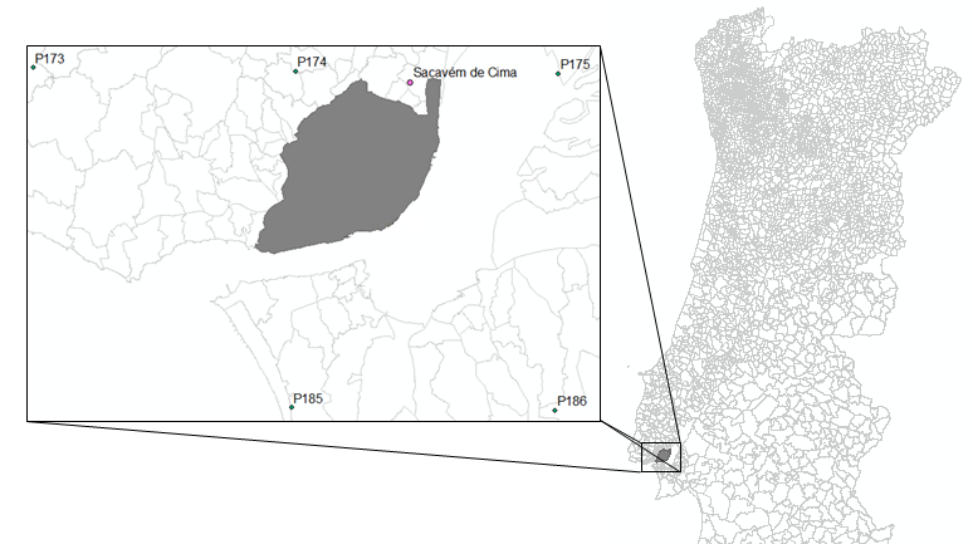
3.2. Urban area

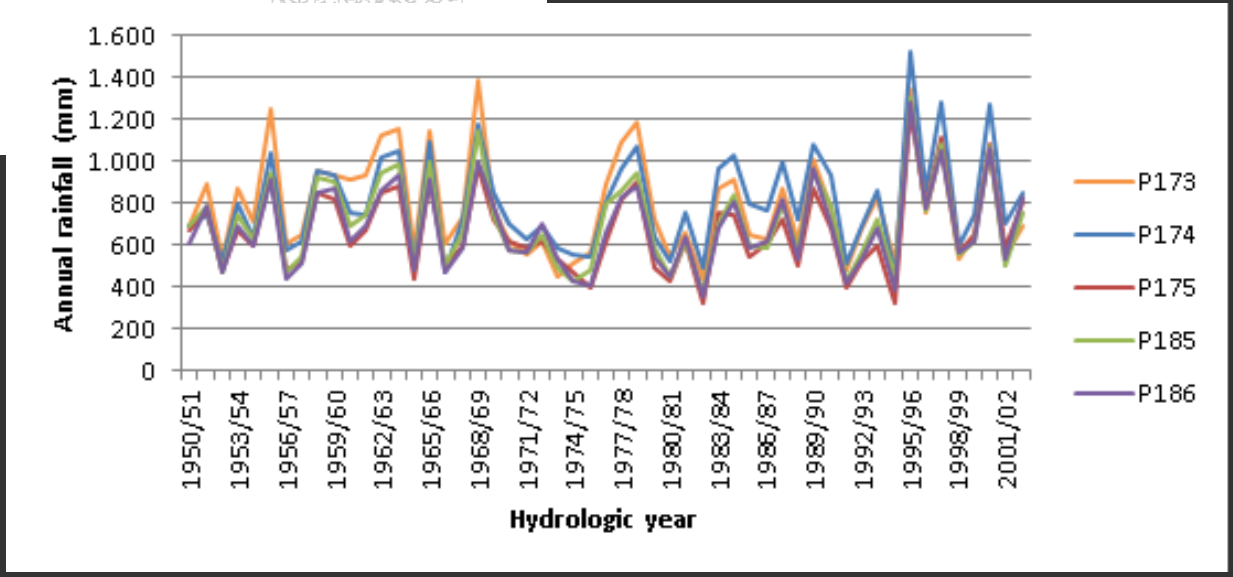


3.2. Urban area

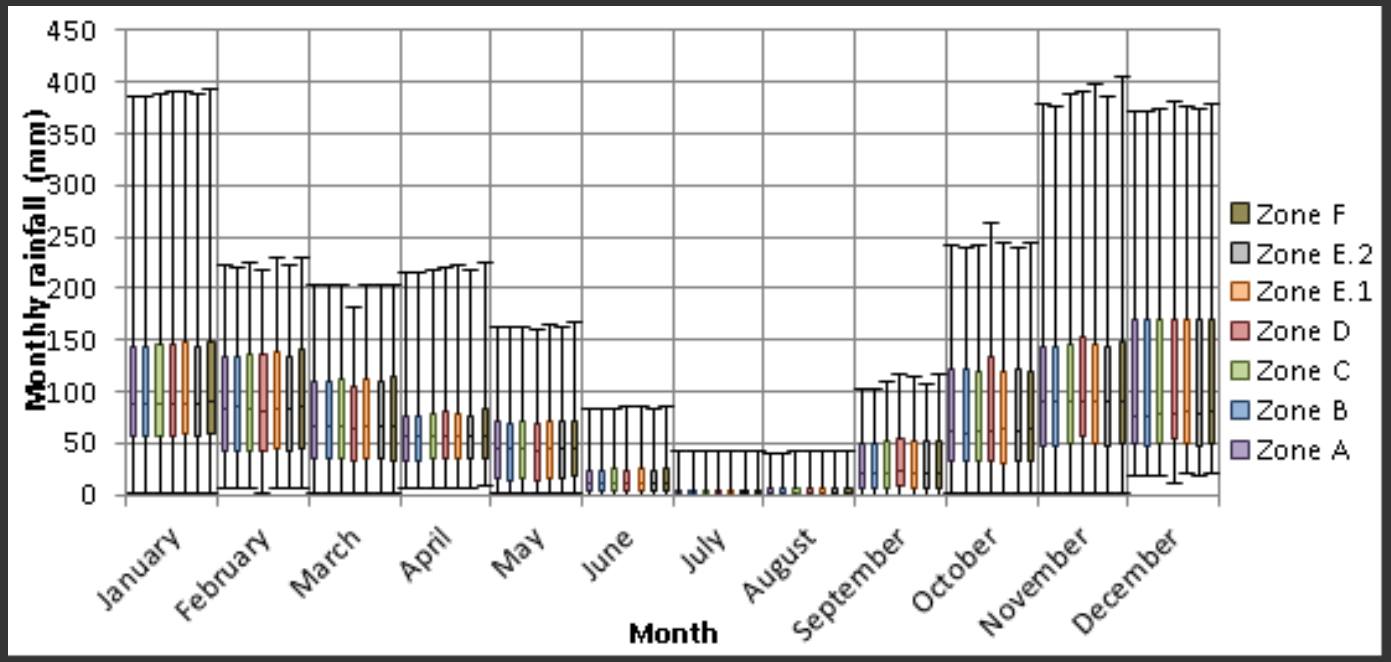
Zone	Floors							Residents	Families	Average family dimension
	1	2	3	4	5	6	≥7			
A	30%	23%	17%	14%	8%	3%	5%	103 796	47 308	2,2
B	15%	15%	19%	22%	16%	7%	6%	125 398	61 419	2,0
C	9%	7%	9%	19%	17%	11%	28%	74 799	34 135	2,2
D	8%	16%	25%	21%	11%	5%	15%	31 812	14 403	2,2
E.1	16%	31%	6%	6%	8%	6%	27%	101 808	43 121	2,4
E.2	14%	30%	11%	10%	11%	5%	20%	92 607	36 824	2,5
F	35%	24%	8%	10%	7%	4%	12%	22 480	8 684	2,6
							Lisbon total	552 700	245 894	2,2

3.3. Hydrologic regime





3.3. Hydrologic regime

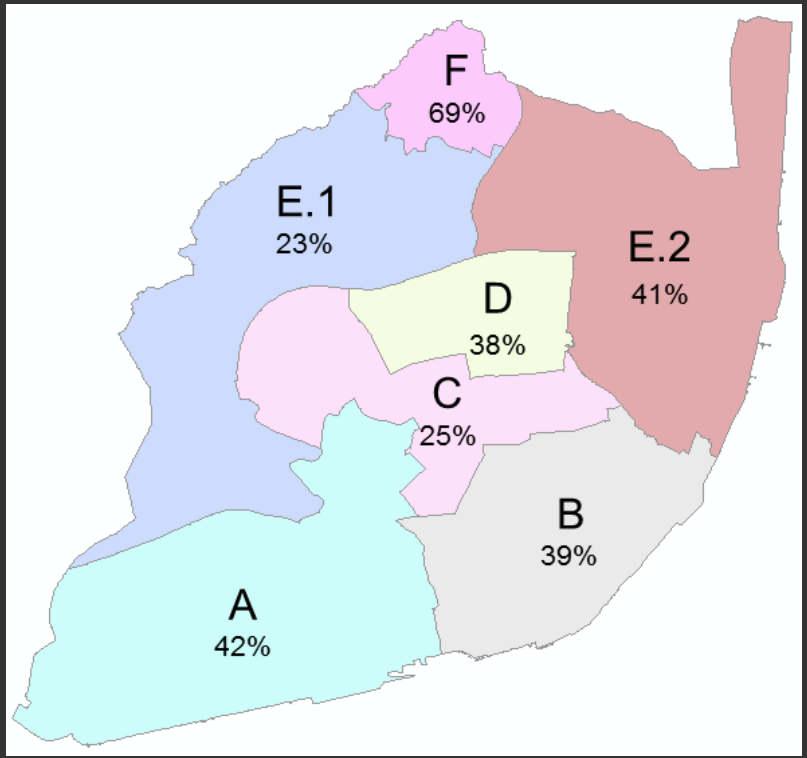


Zone	Roof area (m^2)	Number of floors	Number of dwellings/floor	Number of families	Average family dimension	Estimated number of residents	Number of residents	Average daily water consumption (m3)/building	Average daily non-potable water consumption (m3)/building
A	31,68	1	-	1	2,2	2,2	3	0,438	0,123
A	158,60	2	2	4	2,2	8,8	9	1,314	0,369
B	125,90	3	2	6	2,0	12	12	1,752	0,492
B	229,35	4	2	8	2,0	16	16	2,336	0,656
C	151,63	4	2	8	2,2	17,6	18	2,628	0,738
C	227,90	8	2	16	2,2	35,2	36	5,256	1,476
D	127,19	3	2	6	2,2	13,2	14	2,044	0,574
D	264,97	4	2	8	2,2	17,6	18	2,628	0,738
E.1	24,76	2	-	1	2,4	2,4	3	0,438	0,123
E.1	198,55	9	2	18	2,4	43,2	44	6,424	1,804
E.2	55,00	2	-	1	2,5	2,5	3	0,438	0,123
E.2	420,68	8	-	23	2,5	57,5	58	8,468	2,378
F	55,48	1	-	1	2,6	2,6	3	0,438	0,123
F	102,81	2	-	1	2,6	2,6	3	0,438	0,123

Note: The buildings without value for the number of dwellings per floor are houses with only one family, excluding the 8 floors' building in zone E.2 which has 2 dwellings per floor in the ground level and 3 dwellings per floor in the remaining floors.

3.4. RWH evaluation

Zone	Num. floors	Tank capacity (m^3)	Non-potable water savings (%)
A	1	3	34
A	2	30	53
B	3	15	34
B	4	30	44
C	4	15	29
C	8	15	22
D	3	15	31
D	4	50	46
E.1	2	3	29
E.1	9	7,5	16
E.2	2	7,5	54
E.2	8	30	26
F	1	15	57
F	2	30	86



5. FINAL REMARKS

The methodology proposed uses a mass balance approach and is adjustable to any scale (time and space), allowing for the particularities of the building, neighbourhood, zone or city to be taken into account when assessing the performance of RWHS.

Its application to the city of Lisbon estimates non-potable water savings from 16 to 86% with tanks from 3 to 50 m^3.

It becomes clear that the type of urbanization influences significantly in the potential performance of a RWHS.

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